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(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Tetsuhiro Shiomi et al.

Application No.: 09/476,776

Confirmation No.: 8293

Filed: December 30, 1999

Art Unit: 2627

For: SON-1688 DISK RECORDING AND/OR REPRODUCING APPARATUS AND DISK RECORDING AND/OR REPRODUCING METHOD

Examiner: Kim Kwok CHU

SUBMISSION OF CERTIFIED TRANSLATION OF PRIORITY DOCUMENT

MS Non-Fee Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The Applicant, through its representatives and attorneys, hereby brings to the attention of the Examiner the English language translation of Japanese Application No. JP11-2123.

The above-identified application is entitled to benefit the filing date of Japanese Application No. JP11-2123. These Japanese Applications have priority dates of December 30, 1999, respectively.

Please take this English language translation into account in the examination of this application and make its consideration of record. If the Examiner has any comments or suggestions that could place this application in even better form, the Examiner is requested to telephone the undersigned attorney at 202-955-3750.

Dated: December 12, 2007

Respectfully submitted,

By____________________

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of)	Group Art Unit:2627
Serial No. 09/476,776)	Examiner:K.K.Chu
Filed: December 30,1999)	
Japanese Patent Application)	
JP11-2123 filed in the)	
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January 7, 1999)	
For: DISK RECORDING AND/OR REPRODUCING)	
APPARATUS AND DISK RECORDING AND/OR)	VERIFIED TRANSLATION OF
REPRODUCING METHOD)	PRIORITY DOCUMENT

Honorable Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

I declare that I can read and speak both the English and Japanese languages, and that I have translated, fully and accurately, the following Japanese application(s) for which priority is claimed:

Copies of my English translation(s) of the above priority application(s) are attached hereto.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledgeable that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any registration resulting therefrom.

Dated: December 5, 2007 By: Kimie Takeuchi

Kimie Takeuchi

[Name of Document] SPECIFICATION

[Title of the Invention] DISK RECORDING AND/OR REPRODUCING APPARATUS AND DISK RECORDING AND/OR REPRODUCING METHOD

[SCOPE OF CLAIMS FOR A PATENT]

[Claim 1]

A disk recording and/or reproducing apparatus characterized by comprising:

a spindle chassis that turnably supports a turntable on which an optically-based disk for recording and/or reproducing an information signal is loaded;

a pickup chassis that movably supports an optical pickup device for writing and/or reading the information signal on said optically-based disk loaded on said turntable in a manner coming closer to and going away from the turntable and also that is supported to be capable of oscillating at said spindle chassis; and

a tilt operation mechanism that adjusts a tilt of said optical pickup device to said optically-based disk by oscillating said pickup chassis over said spindle chassis, wherein

a stepping motor is used as a driving source for said tilt operation mechanism and a motor drive circuit is provided to drive said stepping motor at the time of starting an operation of recording and/or reproducing said information signal in order

that a tilt of said pickup chassis is set at a predetermined neutral position.

[Claim 2]

A disk recording and/or reproducing apparatus according to claim 1, characterized in that

said motor drive circuit rotationally drives said stepping motor in one direction by outputting a rated number of pulse signals so that a position rotationally driven by the rated number of pulses including a step-out of the stepping motor is set as a reference position and also rotationally drives the stepping motor in the reverse direction by the number of pulses equivalent to a difference obtained from a comparison between the reference position and the predetermined neutral position.

[Claim 3]

A disk recording and/or reproducing apparatus according to claim 1, characterized in that

said motor drive circuit rotationally drives said stepping motor in one direction by outputting the rated number of pulse signals so that a position rotationally driven by the rated number of pulses including a step-out of the stepping motor is set as a reference position and also rotationally drives the stepping motor in the reverse direction by the predetermined number of pulses from the reference position.

[Claim 4]

A disk recording and/or reproducing method characterized in that a spindle chassis, which turnably supports a turntable on which an optically-based disk for recording and/or reproducing an information signal is loaded, supports a pickup chassis to be capable of oscillating, in which an optical pickup device for writing and/or reading the information signal on said optically-based disk loaded on said turntable is movably supported in a manner coming closer to and going away from the turntable, and a tilt operation mechanism is actuated to oscillate said pickup chassis over said spindle chassis so that a tilt of said optical pickup device is adjusted to said optically-based disk, wherein

a motor drive circuit of said tilt operation mechanism is operated at the time of starting an operation of recording and/or reproducing said information signal in order that a tilt of said pickup chassis is set at a predetermined neutral position.

[Claim 5]

A disk recording and/or reproducing method according to claim 4, characterized in that

said motor drive circuit rotationally drives said stepping motor in one direction by outputting a rated number of pulse signals so that a position rotationally driven by the rated number of pulses including a step-out of the stepping motor is set as a reference position, and rotationally drives the stepping motor in the reverse direction by the number of pulses

equivalent to a difference obtained from a comparison between the reference position and the predetermined neutral position.

[Claim 6]

A disk recording and/or reproducing method according to claim 4, characterized in that

said motor drive circuit rotationally drives said stepping motor in one direction by outputting the rated number of pulse signals so that a position rotationally driven by the rated number of pulses including a step-out of the stepping motor is set as a reference position, and rotationally drives the stepping motor in the reverse direction by the predetermined number of pulses from the reference position.

[Detailed Description of the Invention]

[0001]

[Technical Field Pertinent to the Invention]

The present invention relates to a disk recording and/or reproducing apparatus and a disk recording and/or reproducing method for recording (writing) and/or reproducing (reading) an information signal by moving an optical pickup device along an information recording plane of an optically-based disk while the optically-based disk such as an optical disk and an optical-magnetic disk is rotationally driven as an information recording medium.

[0002]

[Background Art]

In the past, there has been provided a disk recording and/or reproducing apparatus for recording and/or reproducing an information signal on a so-called optically-based disk as an information recording medium, which is generally referred to as an optical disk such as a CD (Compact Disk) and a CD-ROM (Read Only Memory) or an optical-magnetic disk (OD: Optical-Magnetic Disk). The above disk recording and/or reproducing apparatus is configured such that laser light is applied in an approximately vertical direction on an information recording plane of the optically-based disk using an optical head of a optical pickup device while the optically-based disk is loaded horizontally and driven rotationally on a turntable attached to a rotary shaft of a spindle motor. Further, the optical head is moved toward the outside in a radius direction from the center of the optically-based disk in order to write the information signal on the information recording plane and to read the information signal recorded on the information recording plane in advance.

[0003]

In such disk recording and/or reproducing apparatus, it is necessary that the information recording plane of the optically-based disk on which the information signal is recorded and the optical head of the optical pickup device provided to read the information are installed within a range of a predetermined tilt. This is because the tilt of the optical head is substantially dependent on the accuracy of the reproduction of the information

signal. In this case, it is desirable that an optical axis of an objective lens of the optical head is set vertically (90°) to the information recording plane of the optically-based disk in order to perform the highly dense and highly accurate recording and/or reproduction on the optically-based disk. However, there are variations in the tilt of the optically-based disk, verticality of the spindle motor, verticality of the objective lens and the like, and therefore it is difficult to set the optical axis of the objective lens precisely vertical to the information recording plane of the optically-based disk.

[0004]

Therefore, an allowable range of relative tilt angle between the optically-based disk and the objective lens is standardized within 1.2° (the standard for the tilt angle of the optically-based disk is set within 0.6°, and the standard for the tilt angle of the spindle motor and objective lens is set within 0.6°) in the disk recording and/or reproducing apparatus in which the optically-based disk such as the CD and CD-ROM is used as the information recording medium. Further, the optical pickup device is moved being tilted by setting a state of having the optically-based disk mounted at a predetermined position as a reference, and thereby the optical axis of the objective lens is adjusted within the range of predetermined tilt.

[0005]

An apparatus as shown in FIG. 23, for example, is known as the disk recording and/or reproducing apparatus having such a tilt operation mechanism. A disk recording and/or reproducing apparatus 1 in this figure includes a spindle chassis 2 made of a plate-like frame body having an approximately rectangular opening portion provided in the inside, a pickup chassis 3 made of a plate-like frame body similarly having an opening portion, which is slightly smaller than the spindle chassis 2 though, and a tilt operation mechanism that oscillates the pickup chassis over the spindle chassis based on torque of a motor. A pair of axle portions 3a projecting on both sides in the width direction are provided in the pickup chassis 3, while a pair of bearing portions 2a turnably supporting the axle portions 3a are provided in the spindle chassis 2 such that the pickup chassis 3 is supported to be capable of oscillating in the lengthwise direction over the spindle chassis 2 using a combination of the respective pairs of bearing portions 2a and axle portions 3a.

[0006]

A tilt operation mechanism 4 is provided on one side in the lengthwise direction of the spindle chassis 2 so that the pickup chassis 3 oscillates in the lengthwise direction of the spindle chassis 2 by actuating the tilt operation mechanism 4. Further, a spindle motor 5 is fixed on the other side in the lengthwise direction of the spindle chassis 2 in a state that a rotary shaft is directed upward. A turntable 6, on which the optically-

based disk is loaded, is integrally attached to the rotary shaft of the spindle motor 5.

[0007]

In addition, a guide shaft 3b and a guide portion (not illustrated) are installed in parallel at a predetermined interval between them in the pickup chassis 3 in a manner extending in the above-described lengthwise direction. A slide member 8 of an optical pickup device 7 is supported slidably at the guide shaft 3b and guide portion. A rack (not illustrated) is fixed to the slide member 8 and a gear positioned at an end portion of a head feed mechanism 9 is engaged with the rack. The torque is transmitted to the slide member 8 by driving the head feed mechanism 9, and thereby the optical pickup device 7 is moved in a manner coming closer to and going away from the turntable 6.

[0008]

Further, a tilt sensor 10 for detecting a distance to the information recording plane of the optically-based disk loaded on the turntable 6 is mounted on the slide member 8. The tilt sensor 10 is configured such that light is projected toward the information recording plane and a warp of the optically-based disk is detected by receiving the light reflected from the information recording plane. Based on a detection result of the tilt sensor 10, the tilt operation mechanism 4 performs control so that an error signal due to the warp of the optically-based

disk becomes minimum. Accordingly, the tilt of the pickup chassis 3 is changed so that the tilt of the optical axis of an optical head 7a of the optical pickup device 7 can be adjusted to the tilt of the information recording plane of the optically-based disk. There is no need to recognize a neutral point (mechanical center position) of the tilt operation in a case of the disk recording and/or reproducing apparatus using the tilt sensor 10.

[0009]

[Problems to Be Solved by the Invention]

However, such disk recording and/or reproducing apparatus of related art has been configured such that the warp of the optically-based disk is detected by the tilt sensor 10 and the tilt of the optical pickup device 8 is controlled by making the pickup chassis 3 oscillate to minimize the error signal due to the warp, and accordingly there have been such problems that not only costs become higher since the tilt sensor 10 is required but also the tilt control of the optical pickup device 8 becomes complicated and, in addition, a size of the disk drive device 1 is increased. Moreover, there has been also such problem that the accuracy when installing the tilt sensor 10 needs to be strictly controlled since the tilt operation angle by the tilt operation mechanism 4 is around $\pm 1°$.

[0010]

The present invention is made in view of such problems in the related art, and an object of the present invention is to provide a disk recording and/or reproducing apparatus and a disk recording and/or reproducing method in which the tilt operation can be performed without using the tilt sensor by devising a driving source of the tilt operation mechanism, a method of using thereof, and the like so that such problems as described above can be solved.

[0011]

[Means for Solving the Problem]

In order to solve such problems as described above and to achieve the above-described object, a disk recording and/or reproducing apparatus according to claim 1 of the present invention is characterized by comprising a spindle chassis that supports turnably a turntable on which an optically-based disk for recording and/or reproducing an information signal is loaded, a pickup chassis that supports movably an optical pickup device for writing and/or reading the information signal on the optically-based disk loaded on the turntable in a manner capable of coming closer to and going away from the turntable and also that is supported to be capable of oscillating at the spindle chassis, and a tilt operation mechanism that adjusts a tilt of the optical pickup device to the optically-based disk by oscillating the pickup chassis over the spindle chassis; in which a stepping motor is used as a driving source for the tilt

operation mechanism and a motor drive circuit is provided to drive the stepping motor at the time of starting an operation of recording and/or reproducing the information signal in order that the tilt of the pickup chassis is set at a predetermined neutral position.

[0012]

The disk recording and/or reproducing apparatus according to claim 2 of the present invention is characterized in that the motor drive circuit rotationally drives the stepping motor in one direction by outputting a rated number of pulse signals so that a position rotationally driven by the rated number of pulses including a step-out of the stepping motor is set as a reference position and also rotationally drives the stepping motor in the reverse direction by the number of pulses equivalent to a difference obtained from a comparison between this reference position and the predetermined neutral position.

[0013]

The disk recording and/or reproducing apparatus according to claim 3 of the present invention is characterized in that the motor drive circuit rotationally drives the stepping motor in one direction by outputting the rated number of pulse signals so that the position rotationally driven by the rated number of pulses including the step-out of the steeping motor is set as the reference position and also rotationally drives the stepping

motor in the reverse direction by the predetermined number of pulses from this reference position.

[0014]

A disk recording and/or reproducing method according to claim 4 of the present invention is characterized in that the spindle chassis that turnably supports the turntable on which the optically-based disk for recording and/or reproducing the information signal is loaded supports the pickup chassis to be capable of oscillating in which the optical pickup device for writing and/or reading the information signal on the optically-based disk loaded on the turntable is movably supported in a manner coming closer to and going away from the turntable, and the tilt operation mechanism is actuated to oscillate the pickup chassis over the spindle chassis so that the tilt of the optical pickup device is adjusted to the optically-based disk; in which the motor drive circuit of the tilt operation mechanism is operated at the time of starting the operation of recording and/or reproducing the information signal in order that the tilt of the pickup chassis is set at the predetermined neutral position.

[0015]

The disk recording and/or reproducing method according to claim 5 of the present invention is characterized in that the motor drive circuit rotationally drives the stepping motor in one direction by outputting the rated number of pulse signals so

that the position rotationally driven by the rated number of pulses including the step-out of the stepping motor is set as the reference position, and then rotationally drives the stepping motor in the reverse direction by the number of pulses equivalent to the difference obtained from the comparison between this reference position and the predetermined neutral position.

[0016]

The disk recording and/or reproducing method according to claim 6 of the present invention is characterized in that the motor drive circuit rotationally drives the stepping motor in one direction by outputting the rated number of pulse signals so that the position rotationally driven by the rated number of pulses including the step-out of the stepping motor is set as the reference position, and then rotationally drives the stepping motor in the reverse direction by the predetermined number of pulses from this reference position.

[0017]

Since the disk recording and/or reproducing apparatus according to claim 1 of the present invention is configured as described above, the drive of the stepping motor used as the driving source of the motor drive circuit is controlled by the motor drive circuit at the time of starting the operation of recording and/or reproducing the information signal so that the

tilt of the pickup chassis can be set at the predetermined neutral position to the spindle chassis.

[0018]

In the disk recording and/or reproducing apparatus according to claim 2 of the present invention, the motor drive circuit rotationally drives the stepping motor in one direction by outputting the rated number of pulse signals, and then drives rotationally the stepping motor in the reverse direction by the number of pulses equivalent to the difference obtained from the comparison between the reference position rotationally driven by the rated number of pulses including the step-out of the stepping motor and the predetermined neutral position so that the tilt of the pickup chassis can be set at the predetermined neutral position.

[0019]

In the disk recording and/or reproducing apparatus according to claim 3 of the present invention, the motor drive circuit rotationally drives the stepping motor in one direction by outputting the rated number of pulse signals, and then drives rotationally the stepping motor in the reverse direction by the predetermined number of pulses from the reference position rotationally driven by the rated number of pulses including the step-out of the stepping motor so that the tilt of the pickup chassis can be set at the predetermined neutral position.

[0020]

In the disk recording and/or reproducing method according to claim 4 of the present invention, the drive of the stepping motor is controlled by the motor drive circuit at the time of starting the operation of recording and/or reproducing the information signal so that the tilt of the pickup chassis can be set at the predetermined neutral position to the spindle chassis.

[0021]

In the disk recording and/or reproducing method according to claim 5 of the present invention, the motor drive circuit rotationally drives the stepping motor in one direction by outputting the rated number of pulse signals, and then drives rotationally the stepping motor in the reverse direction by the number of pulses equivalent to the difference obtained from the comparison between the reference position rotationally driven by the rated number of pulses including the step-out of the stepping motor and the predetermined neutral position so that the tilt of the pickup chassis can be set at the predetermined neutral position.

[0022]

In the disk recording and/or reproducing method according to claim 6 of the present invention, the motor drive circuit rotationally drives the stepping motor in one direction by outputting the rated number of pulse signals, and then drives rotationally the stepping motor in the reverse direction by the predetermined number of pulses from the reference position

rotationally driven by the rated number of pulses including the step-out of the stepping motor so that the tilt of the pickup chassis can be set at the predetermined neutral position.

[0023]

[Best Mode for Carrying Out the Invention]

Hereinafter, an embodiment of the disk recording and/or reproducing apparatus to which the present invention is applied is described by referring to the accompanied drawings. The disk recording and/or reproducing apparatus according to this embodiment is applied to a disk drive device using a disk tray method in which the optically-based disk such as the CD and CD-ROM of 12 cm in diameter and 8 cm in diameter is used as the information recording medium and the optically-based disk is transported by a disk tray for automatic loading to reproduce (read) information recorded on the optically-based disk.

[0024]

Specifically, FIG. 1 through FIG. 21 are diagrams showing an embodiment of the disk drive device according to the disk recording and/or reproducing apparatus of the present invention, in which FIG. 1 is a perspective view of a disk drive device, FIG. 2 is an exploded perspective view of the same, FIG. 3 is a magnified perspective view showing a main chassis shown in FIG. 2, FIG. 4 is a perspective view showing a disk tray similarly shown in FIG. 2, FIG. 5 is a perspective view showing a base unit and a base holder similarly shown in FIG. 2, FIG. 6 is a

perspective view showing a state in which a biaxial cover is disassembled from the base unit shown in FIG. 5, FIG. 7 is a front view showing the same base unit, FIG. 8 is an exploded perspective view showing the same base unit, and FIG. 9 is a perspective view showing a chuck plate and the like shown in FIG. 2.

[0025]

Further, FIG. 10 and FIG. 11 are cross sections showing a disk drive device in a moving direction of a disk tray, in which FIG. 10 is a vertical cross-section view showing an unloading state and FIG. 11 is a vertical cross-section view showing a loading state. FIG. 12 and FIG. 13 are diagrams showing a base unit according to a disk drive device, in which FIG. 12 is a lateral view showing a state in which a pickup chassis is tilted forward and FIG. 13 is a lateral view showing a state in which the pickup chassis is tilted backward. FIG. 14 is a perspective view showing the lower side of a tilt cam; FIG. 15 is a block diagram showing a schematic configuration of a disk reproducing apparatus; and FIG. 16 is an explanatory diagram showing a schematic configuration of a tilt drive circuit.

[0026]

Further, FIGS. 17 and FIG. 18 are diagrams showing a two-phase excitation state of a tilt motor using a tilt drive circuit, in which FIGS. 17 are explanatory diagrams showing a relation with a rotor stop position and FIG. 18 is a timing

chart showing an excitation pattern. FIGS. 19 and FIG. 20 are diagrams similarly showing one-two phase excitation state of a tilt motor, in which FIGS. 19 are explanatory diagrams showing a relation with a rotor stop position and FIG. 20 is a timing chart showing an excitation pattern. FIG. 21 is an explanatory diagram similarly showing a relation between a stopper position and a rotor stop position in one rotational electric angle of a tilt motor and FIG. 22 is an explanatory diagram showing an initialization operation concept of a tilt motor.

[0027]

As shown in FIG. 1 and FIG. 2, a disk drive unit 11 is configured to have a box-type main chassis 12 having openings on the upper side and front side, a disk tray 13 that is in and out of a front opening portion of the main chassis 12, a base holder 14 that is held and supported to be capable of oscillating in a concave recess portion of the main chassis 12, a base unit 15 that is supported elastically at the base holder 14, and the like.

[0028]

The main chassis 12 is made of a rectangular box having a shallow bottom and a concave recess portion 16 formed into an approximate rectangle extending to a rear end portion is provided in a center part of a bottom plane thereof as shown in a magnified view of FIG. 3. The bottom plane of the concave recess portion 16 is made into a slope descending forward, and a

pair of bearing portions 17 and 17 having openings on the upper side are provided at both edge portions in a right-left direction Y horizontally orthogonal with an anterior-posterior direction X in a rear end portion of the anterior-posterior direction X that is the direction of putting in and out the disk tray 13. A pair of axle portions 14a and 14b provided on the both sides of the rear end portion of the base holder 14 are supported respectively and pivotally at the pair of bearing portions 17 and 17 in a turnable manner. Further, a guide projection strip 18 and an elongate hole 19 which are parallel with each other and extend in the right-left direction Y are provided in a front end portion of the concave recess portion 16.

[0029]

Furthermore, a motor seat portion 12a is formed on one side of the front end portion of the bottom plane surrounding the concave recess portion 16 of the main chassis 12. A loading motor 20 is attached to the seat portion 12a by screwing on the back plane of the main chassis 12. A rotary shaft 20a of the loading motor 20 is projected into the concave recess portion 16 by penetrating through the bottom plane of the main chassis 12 and a driving pulley 21 is fixed to the rotary shaft 20a. One end of a rubber belt 22 as a power transmission member is laid on the driving pulley 21, and the other end of the rubber belt 22 is laid on a coupled driving pulley 23 that is disposed at an

approximately center part of the front end portion of the bottom plane.

[0030]

The coupled driving pulley 23 is supported turnably at a first support axle 12b erected in the front end portion of the bottom plane of the main chassis 12 and is retained by a fixing screw 24 that is engaged with the first support axle 12b. A gear (not illustrated) is integrally formed in a lower plane of the coupled driving pulley 23, and a middle gear 25b of an intermediary gear 25 is engaged with this integrally formed gear. The intermediary gear 25 is supported turnably at a second support axle 12c similarly erected in the front end portion of the bottom plane. A driving gear 26 supported turnably at a third support axle 12d similarly erected in the front end portion of the bottom plane is engaged with an upper gear 25a that is provided in an upper plane of the middle gear 25b of the intermediary gear 25.

[0031]

Moreover, a lower gear 25c is formed integrally in a lower plane of the middle gear 25b of the intermediary gear 25. A rack 27a of a chuck cam 27 is engaged with the lower gear 25c as shown in FIG. 10 and other drawings. The chuck cam 27 is made of a block-shaped member formed into an oblong rectangle, and the rack 27a projecting to one side is formed in an upper part of the chuck cam 27. In addition, a guide groove extending in the

lengthwise direction is provided in a lower plane of the chuck cam 27. Further, a cam groove 27b for oscillating the base holder 14 in a vertical direction is provided in a plane on the opposite side to the rack 27a of the chuck cam 27.

[0032]

The cam groove 27b of the chuck cam 27 has an upper and lower horizontal portions set at both ends in the lengthwise direction and a slope portion set in the middle being diagonally continuous with the upper and lower horizontal portions. A cam pin 28 provided in a manner projecting forward in a front end plane of the base holder 14 is slidably engaged with the cam groove 27b. Further, operation pins 27c and 27d for slidingly operating the chuck cam 27 by manual operation are provided in the upper plane and lower plane of the chuck cam 27. One lower operation pin 27d is projected to the back plane side by penetrating through the elongate hole 19 of the main chassis 12 as shown in FIG. 10 and other drawings.

[0033]

A spring bearing piece 27e is provided in a base portion of the upper operation pin 27c of the chuck cam 27, and one end of a tension coil spring 29 is latched on the spring bearing piece 27e. The other end of the tension coil spring 29 is latched on a spring bearing piece 12e provided in the seat portion 12a of the main chassis 12. The chuck cam 27 is constantly pulled toward the seat portion 12a by spring force of the tension coil spring

29. Therefore, when the chuck cam 27 is positioned at an end portion on the side of seat portion 12a that is a pulling direction of the tension coil spring 29, the cam pin 28 is placed at the lower horizontal portion of the cam groove 27b so that the base holder 14 is in a state of descending forward. On the other hand, when the chuck cam 27 is positioned at the end portion on the side of being apart from the seat portion 12a against the spring force of the tension coil spring 29, the cam pin 28 is placed at the upper horizontal portion of the cam groove 27b so that the base holder 14 is in a state of being approximately horizontal.

[0034]

In addition, the front opening portion of the main chassis 12 is set as a tray entrance 30. A plurality of tray guides 31 are provided in each inner plane of lateral pieces surrounding both lateral portions of the tray entrance 30, and a plurality of guide pins 32a and 32b are provided in a bottom piece. In this configuration, a pair of guide rails 13a, 13a, and the like provided on both right and left lateral portions of the disk tray 13 are controlled by those tray guide 31 and guide pins 32a and 32b, and thereby the disk tray 13 is held movably in the anterior-posterior direction X for the main chassis 12 and can be put in and out of the tray entrance 30.

[0035]

The disk tray 13 is configured to have a disk holding portion 34 made of a round-shaped concave recess portion in which an optical disk 33 such as a CD and a CD-ROM representing a specific example of the optically-based disk can be held in a horizontal position and an elongate hole-shaped opening portion 35 opened in a manner extending backward along the tray center from a center part of the disk holding portion 34 as shown in FIG. 4 and other drawings. The disk holding portion 34 has a large diameter portion 34a on which the optical disk 33 of 12 cm in diameter is mounted and a small diameter portion 34b which is made of a concave portion formed in the center part of the large diameter portion 34a and on which the optical disk 33 of 8 cm in diameter is mounted.

[0036]

In addition, the opening portion 35 of the disk tray 13 is opened further ahead of the center part of the small diameter portion 34b of the disk holding portion 34 and is extended to the outside of the disk holding portion 34 by cutting away a part of the large diameter portion 34a. Size and shape of the opening portion 35 are made into the size and shape through which an upper portion of the base unit 15, which is described later in detail, can completely enters. The right and left pair of guide rails 13a and 13a extending parallel in the anterior-posterior direction are provided on both right and left lateral edges of the disk tray 13.

[0037]

Further, a rack and a guide groove extending in parallel with the guide rails 13a are integrally provided on one side of the lower plane of the disk tray 13, although not illustrated. The driving gear 26 supported at the main chassis 12 is engaged with the rack so that the disk tray 13 is moved forward and backward by the torque of the driving gear 26. A length of the rack is set such that the engagement with the driving gear 26 is released at a place where the disk tray 13 is moved just before reaching the most rear end. Moreover, in this configuration, the guide pin 32a erected at the front portion of the main chassis 12 is slidably engaged with the guide groove so that the movement of the disk tray 13 is also controlled to move linearly in the anterior-posterior direction X by the guide pin 32a.

[0038]

The anterior-posterior movement of the disk tray 13 is detected by a tray feed detection switch 37 so that whether the disk tray 13 moves in an eject direction for ejecting the optical disk 33 or moves in a set direction for transporting the optical disk 33 to the disk loading portion can be detected by an operation of the tray feed detection switch 37. The tray feed detection switch 37 is fixed to a printed circuit substrate 38 attached to the lower plane of the main chassis 12. Further, an actuator 37a of the tray feed detection switch 37 is projected

over a movement track of the disk tray 13 by penetrating a through-hole provided in the main chassis 12.

[0039]

A connection terminal 39 for supplying the power to the loading motor 20 and the like are mounted and, in addition, a cam detection switch 40 for detecting the operation of the chuck cam 27 is installed in the printed circuit substrate 38. An actuator 40a of the cam detection switch 40 is disposed on the movement track of an input portion 27f provided in the chuck cam 27. Further, in this configuration, the cam detection switch 40 is turned on when the chuck cam 27 moves a predetermined distance in a direction apart from the seat portion 12a. Reference numeral 41 shown in FIG. 3 denotes a cover plate attached to the lower plane of the main chassis 12.

[0040]

The base holder 14 held in such concave recess portion 16 of the main chassis 12 is made into a shape shown in FIG. 5 and other drawings. More specifically, the base holder 14 is made of an approximately rectangular box having a shallow bottom, in which the above-described cam pin 28 is provided in a front plate and a pair of axle portions 14a are provided at the rear end portions of both right and left lateral plates. An opening hole 42a for avoiding a contact with the spindle motor and the like and an opening hole 42b for passing the flexible printed circuit substrate and the like are provided in the bottom plane

of the base holder 14. Further, convex portions 14b for positioning and elastically supporting the base unit 15 is provided at three places in an upper plane of the bottom plate. Gourd-shaped insulators 43 made of a rubber-like elastic body such as rubber and plastic are mounted on the convex portions 14b.

[0041]

The base unit 15 is configured as shown in FIG. 5 through FIG. 8. More specifically, the base unit 15 includes a spindle chassis 44 that turnably supports a turntable 47 on which the optical disk 33 provided for the reproduction of an information signal is loaded, a pickup chassis 45 that movably supports an optical pickup device 48 for reading the information signal from the optical disk 33 loaded on the turntable 47, and the like. The spindle chassis 44 and the pickup chassis 45 constitute the base chassis 36.

[0042]

The spindle chassis 44 of the base unit 15 is made of frame-shaped members having a front piece 44a, right and left lateral pieces 44b and 44c, and a rear piece 44d as shown in FIG. 8, in which only the front piece 44a is set approximately two times higher than the other pieces. Support portions 49 for supporting the insulators 43 are provided at total three places which are one corner portion of the front piece 44a, a front end portion of the lateral piece 44b positioned opposite thereto,

and an approximately center portion of the rear piece 44d. The support portion 49 is formed into a planar C-shaped claw, and a constricted portion of the insulator 43 is inserted into the support portion 49. Further, a fixing screw (not illustrated) is inserted into the insulator 43 from an upper side, and a screw portion of a top end is screwed into a screw hole provided in an upper plane of the convex portion 14b. Accordingly, the base unit 15 is supported elastically at the base holder 14 through three insulators 43.

[0043]

Also, a motor mounting seat 50 is provided in the front piece 44a of the spindle chassis 44 by expanding a part of the front piece 44a upward. A spindle motor 51 is installed in the inside of the motor mounting seat 50 and is integrated by being tightly fixed thereto using a plurality of fixing screws 52a. A rotary shaft 51a of the spindle motor 51 is projected to the upper side of the spindle chassis 44 by penetrating a through-hole 50a of the motor mounting seat 50.

[0044]

An offset washer 53 is fittingly fixed to the rotary shaft 51a of the spindle motor 51 and also the turntable 47 is fittingly fixed to the upper side of the offset washer 53. A ring fixing portion 47a is protrusively formed in a center part of an upper plane of the turntable 47, and a chucking ring 54 is fittingly fixed to the ring fixing portion 47a. A magnet 54a is

buried concentrically with a center hole in the chucking ring 54. The optical disk 33 is positioned on the turntable 47 by fitting the center hole of the optical disk 33 to the chucking ring 54.

[0045]

Reference numeral 55 shown in FIG. 8 denotes an offset spring that controls the movement of the rotary shaft 51a in an axis direction. The offset spring 55 is installed in a manner traversing the motor mounting seat 50 such that a middle portion thereof is engaged with the offset washer 53 and both end portions thereof are latched on the motor mounting seat 50.

[0046]

Further, a tilt motor 56 is installed side by side with the spindle motor 51 in the inside of the motor mounting seat 50. The tilt motor 56 serves as the driving source of the tilt operation mechanism, for which a stepping motor of bipolar two-phase winding is used. The tilt motor 56 is installed in the inside of the motor mounting seat 50 in a manner being tightly fixed by using one fixing screw 52b. A rotary shaft 56a of the tilt motor 56 is projected to the upper side of the spindle chassis 44 by penetrating through a hole 50b of the motor mounting seat 50. A tilt gear 57 is fittingly fixed to the rotary shaft 56a of the tilt motor 56, and a gear portion 58a of a tilt cam 58 is engaged with the tilt gear 57.

[0047]

The tilt cam 58 represents a specific example of a member for oscillating the pickup chassis 45 and has the gear portion 58a provided in the lower side and a cam plane 58b provided in an upper end plane. The cam plane 58b of the tilt cam 58 has a slope portion extending helically over 360° so that the pickup chassis 45 makes a oscillating operation in the vertical direction, more specifically a tilt operation, by a stroke h in a height direction of the cam plane 58b. The tilt cam 58 is turnably supported at a support axle 59 that is erected in an upper plane of the front piece 44a of the spindle chassis 44. A stopper boss 59a similarly projected to the upper plane of the front piece 44a is provided in the vicinity of the support axle 59.

[0048]

A lib portion 58c provided in the lower plane of the tilt cam 58 is brought into fitting contact with the stopper boss 59a as shown in a magnified view of FIG. 14. A positional relation between the rib portion 58c of the tilt cam 58 and the stopper boss 59a is set such that a later-described cam piece 73 being in contact with the cam plane 58b comes to the highest position when the rib portion 58c is rotated in one direction by rotation of the tilt cam 58 and is brought to fittingly contact with one plane of the stopper boss 59a, and the cam piece 73 being in contact with the cam plane 58b comes to the lowest position when the rib portion 58c is rotated in the reverse direction and

brought to fittingly contact with the other plane of the stopper boss 59a. An operation of the tilt motor 56 for controlling the rotational movement of the tilt cam 58 is described later in detail.

[0049]

In addition, the lateral pieces 44b, 44c and rear piece 44d of the spindle chassis 44 are formed such that a cross-sectional shape of each piece becomes an L-shape over an approximately whole length in the lengthwise direction, and the rigidity of the whole spindle chassis 44 is increased by having such cross-sectional shape. Further, a pair of bearing portions 60 and 61 are respectively provided in a manner extending out horizontally in an approximately center portion in each lengthwise direction of both lateral pieces 44b and 44c. A pair of turnable axle portions 63 provided in the pickup chassis 45 are held turnably in the bearing portions 60 and 61.

[0050]

One bearing portion 60 extends out intensively to the outside and includes a box rim 60a of a box shape having an opening on the upper side and a V-shaped bearing plane 60b provided in the inside of the box rim 60a. One turnable axle portion 63 is mounted on the bearing plane 60b and the mounted turnable axle portion 63 is pressed from the top by a retainer piece 62 in order to retain the turnable axle portion 63. In addition, the retainer piece 62 is tightly fixed to the box rim

60a using a fixing screw 52c. The other bearing portion 61 includes a V-shaped bearing plane 61a and a gate-shaped retainer piece 61b surrounding the bearing plane 61a. Since the retainer piece 61b is integrally formed with the lateral piece 44c, the turnable axle portion 63 is turnably held between the bearing plane 61a and the retainer piece 61b by inserting the other turnable axle portion 63 from the inner side.

[0051]

Also, the pickup chassis 45 is formed into an approximately same size such that a shape of a planar view is approximately same as the shape excluding the front piece 44a of the spindle chassis 44. More specifically, the pickup chassis 45 is disposed behind the front piece 44a of the spindle chassis 44 and is made of frame-shaped members having a front piece 45a disposed adjacent to the front piece 44a, a pair of lateral pieces 45b and 45c disposed opposing on the right and left, and a rear piece 45d disposed continuously at the rear. Further, an opening portion 64, through which an optical head 68 of the optical pickup device 48 is penetrated, is provided in the inside of the frame-shaped members.

[0052]

Furthermore, the lateral pieces 45b, 45c and the rear piece 45d excluding the front piece 45a of the pickup chassis 45 are formed such that a cross-sectional shape of each piece becomes the L-shape over the whole length in the lengthwise direction,

and the rigidity of the whole pickup chassis 45 is increased by having such cross-sectional shape. Further, the above-described pair of turnable axle portions 63 are respectively installed in a manner jetting out in an approximately center portion in each lengthwise direction of both lateral pieces 45b and 45c. Heights of the lateral pieces 45b, 45c and rear piece 45d are set into an approximately similar height to that of the lateral piece 44b of the spindle chassis 44 and the like. Therefore, the pickup chassis 45 is overlapped with a predetermined position of the spindle chassis 44 and thereby the heights of the overlapped portions become approximately same as the height of the front piece 44a of the spindle chassis 44 in this configuration.

[0053]

On the other hand, the front piece 45a of the pickup chassis 45 is formed into a plate-like piece such that the right and left lateral pieces 45b and 45c are connected therewith at upper planes alone. Then, a slope portion 45e lowered on the side of one lateral piece 45b, inclining in a lateral direction, which is an extending direction, is provided in the upper plane of the front piece 45a. The front piece 45a constitutes an edge portion of the pickup chassis 45 that enters under the turntable 47. The slope portion 45e is provided in the front piece 45a of the pickup chassis 45 as described above, and thereby the number of parts can be reduced in comparison to the base chassis in

related art and also assembly work can be facilitated because of the improvement in assembly.

[0054]

In addition, positioning bosses 45f are provided in an upper plane of the rear piece 45d of the pickup chassis 45. Based on the positioning by the bosses 45f, a light-shielding plate 65 is tightly fixed on the rear piece 45d using a fixing screw 52d. The light-shielding plate 65 is formed into a cross-sectional shape of approximate L-shape and covers the upper side of the optical head 68, particularly an objective lens 68a, of the optical pickup device 48 which is moved to the most outside.

[0055]

Moreover, an insertion through-hole 66a is provided in a front edge of one lateral piece 45b of the pickup chassis 45, and a bearing portion 66b is provided in a rear end portion. A bearing member provided in a feed motor 70 is fit into the front insertion through-hole 66a, and a top end portion of a feed shaft 69 inserted through the insertion though-hole 66a is supported turnably at the bearing portion 66b. The feed shaft 69 is made into a rotary shaft of the feed motor 70 in such a manner that a helical spring groove is formed on an outer circumferential surface and the feed shaft 69 itself constitutes a part of a rotor of the feed motor 70. The feed motor 70 is fixed to the front edge of the lateral piece 45b in a manner projecting to the front side of the pickup chassis 45 by

tightening a bracket 70a of the fixed side using two fixing screws 52e.

[0056]

A guide shaft 71 is installed in a manner being in parallel with the feed shaft 69 in the inside of the other lateral piece 45c of the pickup chassis 45 on the opposite side of the feed shaft 69. Therefore, a pair of insertion through-holes 72 are provided in the front edge and rear edge of the lateral piece 45c, and both ends of the guide shaft 71 is supported at the pickup chassis 45 by press-fitting both end portions into both insertion through-holes 72.

[0057]

Furthermore, a cam piece 73 projecting on the side of tilt cam 58 is provided in an upper front edge of the other lateral piece 45c of the pickup chassis 45. A free end of a plate spring 74 is set in press-contact with the cam piece 73 so that the cam piece 73 is biased by the spring force of the plate spring 74 and is brought into press-contact with the cam plane 58b of the tilt cam 58 positioned on the lower side. Further, a fixed end of the plate spring 74 is tightly fixed to the upper plane of the front piece 44a of the spindle chassis 44 using a fixing screw 52f.

[0058]

The optical pickup device 48 supported movably by the feed shaft 69 and guide shaft 71 can be brought closer to and away

from the turntable 47 by being guided along both shafts 69 and 71. The optical pickup device 48 has a slide member 75 on which the optical head 68 is mounted. A bearing hole 75a is provided on one side of the slide member 75, and the feed shaft 69 is slidably inserted through the bearing hole 75a. A rack portion 76a of a slidable rack 76 attached to a lower plane of the slide member 75 is engaged with the screw groove of the feed shaft 69. The rack portion 76a is integrally formed with a fixed piece 76b through an elastic piece, and the fixed piece 76b is tightened using a fixing screw 52g in order to fix the slidable rack 76 to the slide member 75. Also, a bearing portion 75b is provided on the other side of the slide member 75, and the guide shaft 71 is slidably placed and held in the bearing portion 75b.

[0059]

A head feed mechanism for moving the optical pickup device 48 is configured to have the above-described feed shaft 69, feed motor 71 and slidable rack 76. Further, a deceleration mechanism is configured to have the feed shaft 69 and the slidable rack 76. Moreover, the tilt operation mechanism for adjusting the tilt by oscillating the pickup chassis 45 over the spindle chassis 44 is configured to have the tilt motor 56, the tilt gear 57, the tilt cam 58, the stopper boss 59a, the cam piece 73 and the plate spring 74.

[0060]

The optical head 68 of the optical pickup device 48 has a biaxial actuator that can move independently the objective lens 68a in a focusing direction (vertical direction) and in a tracking direction (horizontal direction). The electromagnetic force is mostly used as the driving force of the biaxial actuator, and the biaxial actuator of a plate spring method categorized as a variation in the method of supporting movable portion is adopted in this embodiment. However, it is obvious that other forms such as wire support method, hinge method, and axial sliding method can be optionally applied as the biaxial actuator. It should be noted that reference numeral 77 shown in FIG. 8 denoted a biaxial cover for covering the biaxial actuator, and an opening window 77a for exposing the objective lens 68a is provided in the biaxial cover 77.

[0061]

In addition, a chuck holder 80 is installed in the upper part of the main chassis 12 in a manner traversing the upper side of the disk tray 13 as shown in FIG. 2. The chuck holder 80 is made of a plate of thin and horizontally elongated rectangle and a through-hole 80a is provided in an approximately center part in the lengthwise direction thereof as shown in a magnified view of FIG. 9. Three leg pieces 82 of a chuck plate 81 are loosely inserted through the through-hole 80a. The three leg pieces 82 are disposed in a circular arc such that outer circumferences thereof form a part of the circle, and a disc-

shaped yoke 83 made of an iron plate or the like attracted by the magnet 54a built in the chucking ring 54 is held inside the leg pieces 82.

[0062]

A yoke retainer plate 84 is attached to a top end portion of each leg piece 82 projecting to the upper side by penetrating through the through-hole 80a of the chuck holder 80. The chuck holder 80 is held between the yoke retainer plate 84 and the chuck plate 81 while maintaining a predetermined space so that the chuck plate 81 becomes movable in a direction orthogonal to a planar direction thereof within a range of the predetermined space. Also, in this configuration, a space is set between the through-hole 80a and the three leg pieces 82 so that the chuck plate 81 can move in the planar direction thereof within the range of the set space.

[0063]

It should be noted that ABS resin is suitably used as a material of the above-described main chassis 12, disk tray 13 and base holder 14, however, other synthetic resins are apparently applicable and, in addition, metals such as aluminum alloy can also be used. Also, PPS (Polyphenylene Sulfide) containing 65% of glass fiber is suitable as the material for the spindle chassis 44 and pickup chassis 45 included in the base chassis 36 but other synthetic resins are obviously

applicable and, in addition, metals such as aluminum alloy can also be used.

[0064]

A schematic configuration of a tilt drive control system of the above-described disk drive device 11 is shown in FIG. 15. The optical disk 33 loaded on the turntable 47 is integrally and rotationally driven by the torque of the spindle motor 51. Further, the tilt of the optical head 68 of the optical pickup device 48 having the objective lens face the information recording plane of the optical disk 33 is changed through the oscillating operation of the pickup chassis 45 by the drive of the tilt motor 56. The information signal read from the information recording plane by the optical pickup device 48 is supplied to a PLL circuit 90. The PLL circuit 90 is a circuit that generates a synchronization signal at every basic cycle to identify whether a code of a pulse signal obtained by rectifying the detected information signal is "1" or "0".

[0065]

The signal outputted from the PLL circuit 90 is supplied to a jitter measurement circuit 91. The jitter measurement circuit 91 is a circuit for measuring the jitter that is the fluctuation of a digital signal in a direction of time axis and for outputting numerically an amplitude of the fluctuation. Since a code error occurs and the information signal becomes unreadable in a case that the jitter deteriorates, the jitter measurement

circuit is provided to prevent such problem. The signal outputted from the jitter measurement circuit 91 is supplied to a system controller 92. The system controller 92 has a built-in memory 92a, in which predetermined information is recorded in advance and also information is further written whenever necessary so that the memory 92 is used for controlling the disk drive device 11.

[0066]

The system controller 92 is connected to a servo controller 93 in a manner capable of mutually exchanging the signals so that the signal is outputted to a motor drive circuit 94 based on the signal supplied from the system controller 92. The motor drive circuit 94 is provided for controlling the drive of tilt motor 56 and outputs a control signal so that the tilt motor 56 is driven in normal rotation or reverse rotation depending on necessity. Because of the rotational operation of the tilt motor 56, the pickup chassis 45 changes to a state of being tilted forward (tilt down stopper position) shown in FIG. 12 or a state of being tilted backward (tilt up stopper position) shown in FIG. 13 as the maximum level of tilt movement according to the rotational direction. The tilt control is executed by the tilt operation mechanism within the oscillating range of the pickup chassis 45.

[0067]

The motor drive circuit 94 includes such a configuration as shown in FIG. 16. The motor drive circuit 94 is configured to have a microcomputer (CPU) 95 of 8-bit parallel processing, four voltage current amplifiers 96a through 96d, two coils 97a and 97b, and the like, for example. The microcomputer 95 has four output terminals A, XA, B, and XB, and each of the voltage current amplifiers 96a through 96d is connected to each of output terminals A, XA, B, and XB. Further, one pair of the voltage current amplifiers 96a and 96b are connected through the coil 97a of phase A, and the other pair of the voltage current amplifiers 96c and 96d are connected through the coil 97b of phase B. The phase A coil 97a and the phase B coil 97b are disposed at respective phases having rotational displacement of approximately 90° to a rotor 85 that is the rotary shaft 56a of the tilt motor 56, and an electric current Ia is applied to the phase A coil 97a and an electric current Ib is applied to the phase B coil 97b.

[0068]

The drive of the tilt motor 56 is controlled as shown in FIGS. 17 through FIG. 22, for example, by the motor drive circuit 94 having such configuration. More specifically, FIGS. 17 are diagrams for explaining a basic operation of the tilt motor 56 using the stepping motor based on the bipolar two-phase structure. The tilt motor 56 is configured to make actually one turn per every 20 steps by the two-phase excitation (one turn

per every 40 steps in a case of the one-two phase excitation), and the tilt cam 58 is set to make one turn per every two turns of the tilt motor 56. Therefore, the tilt cam 58 makes one turn each time the tilt motor 56 makes two turns, and the cam piece 73 being in contact with the cam plane 58b moves from the tilt down position to the tilt up position.

[0069]

Describing the basic operation based on the bipolar two-phase structure of the tilt motor 56, two-phase coil portions 86a, 86b and 87a, 87b are disposed at equiangular intervals on the outside of the rotor 85 having two poles of N-pole and S-pole interlocked in a direction of diameter. The two-phase coil portions 86a, 86b and 87a, 87b are disposed opposing across the rotor 85 and orthogonally to each other, and the electric current flows in a positive direction (direction flowing from phase A- to phase A+, and similarly direction flowing from phase B- to phase B+) and the reverse direction (direction flowing from phase A+ to phase A-, and similarly direction flowing from phase B+ to phase B-) in each phase.

[0070]

Excitation patterns according to the two-phase excitation in a case that such tilt motor 56 is used are shown in FIGS. 17 and 18, and the excitation patterns according to the one-two phase excitation are shown in FIGS. 19 and 20. First, the electric current Ia in positive direction is applied to the

first phase (hereinafter, referred to as "phase A") and the electric current Ib in negative direction is applied to the second phase (hereinafter, referred to as "phase B") at timing t0, and then the rotor 85 is in a state as shown in FIG. 17A, in which the N-pole stops opposing the phase A+ that is t0 of the 0th position. After shifting to timing t1 from this state, the electric current Ib of the phase B is switched in the positive direction while keeping the electric current Ia in positive direction flowing in the phase A, and then the rotor 85 changes into a state shown in FIG. 17B, in which the N-pole stops at the middle of the phase A+ and phase B+ that is the first position t1.

[0071]

Next, after shifting to timing t2, the electric current Ia of the phase A is switched in the negative direction while keeping the electric current Ib in positive direction flowing in the phase B, and then the rotor 85 is in a state as shown in FIG. 17C, in which the N-pole stops opposing the phase B+ that is the second position t2. Furthermore, after shifting to timing t3, the electric current Ib of the phase B is switched in the negative direction while keeping the electric current Ia in negative direction flowing in the phase A, and then the rotor 85 is in a state as shown in FIG. 17D, in which the N-pole stops at the middle of the phase B+ and phase A- that is the third position t3.

[0072]

At the subsequent fifth to eighth steps, the electric currents Ia and Ib are applied similarly to the above-described first through fourth steps in a state where the N-pole and the S-pole are reversed in FIGS. 17A through 17D, and then the rotational position of the rotor 85 changes according to the direction of electric current. More specifically, the N-pole of the rotor 85 stops opposing the phase A- of the fourth position t4 at timing t4, and the N-pole of the rotor 85 stops at the middle of the phase A- and phase B- of the fifth position t5 at timing t5. Further, the N-pole of the rotor 85 stops opposing the phase B- of the sixth position t6 at timing t6, and the N-pole of the rotor 85 stops at the middle of the phase B- and phase A+ of the seventh position t7 at timing t7.

[0073]

As described above, the rotary shaft 56a that is the rotor makes one turn through the eight steps from the timing t0 to the timing t7. It should be noted that timing t3 of the second round in FIG. 18 shows a state in which the electric current flowing in the phase A and phase B are shut off all together.

[0074]

Next, the excitation patterns according to the one-two phase excitation are described by referring to FIGS. 19 and 20. First, the electric current Ia in positive direction is applied to the phase A and the electric current Ib of the phase B is

shut off at timing t0, and then the rotor 85 is in a state as shown in FIG. 19A, in which the N-pole stops opposing the phase A+ that is the 0th position t0. After shifting to timing t1 from this state, the electric current Ib in positive direction is applied also to the phase B while keeping the electric current Ia in positive direction flowing in the phase A, and then the rotor 85 is into a state as shown in FIG. 19B, in which the N-pole stops at the middle of the phase A+ and phase B+ that is the first position t1. Next, after shifting to timing t2, the electric current Ia of the phase A is shut off while keeping the electric current Ib in positive direction flowing in the phase B, and then the rotor 85 is into a state as shown in FIG. 19C, in which the N-pole stops opposing the phase B+ that is the second position t2.

[0075]

Further, after shifting to timing t3, the electric current Ia in negative direction is applied to the phase A while keeping the electric current Ib in positive direction flowing in the phase B, and then the rotor 85 is into a state as shown in FIG. 19D, in which the N-pole stops at the middle of the phase B+ and phase A- that is the third position t3. Next, after shifting to timing t4, the electric current Ib of the phase B is shut off while keeping the electric current Ia in negative direction flowing in the phase A, and then the rotor 85 is into a state as shown in FIG. 19E, in which the N-pole stops opposing the phase

A- that is the fourth position t4. Furthermore, after shifting to timing t5, the electric current Ib in negative direction is applied also to the phase B while keeping the electric current Ia in negative direction flowing in the phase A, and then the rotor 85 is into a state as shown in FIG. 19F, in which the N-pole stops at the middle of the phase A- and phase B- that is the fifth position t5.

[0076]

Next, after shifting to timing t6, the electric current Ia of the phase A is shut off while keeping the electric current Ib in negative direction flowing in the phase B, and then the rotor 85 is into a state as shown in FIG. 19G, in which the N-pole stops opposing the phase B- that is the sixth position t6. Further, after shifting to timing t7, the electric current Ia in positive direction is applied to the phase A while keeping the electric current Ib in negative direction flowing in the phase B, and then the rotor 85 is into a state as shown in FIG. 19H, in which the N-pole stops at the middle of the phase B- and phase A+ that is the seventh position t7.

[0077]

Thereafter, the above-described eight steps are repeated after shifting to timing t0 that is timing t8. The rotary shaft 56a of the rotor makes one turn in terms of the electric angle, which is mechanically 1/5 turn, through such operation state of the eight steps. Then, the tilt cam 58 makes one turn by two

turns of the rotary shaft 56a. It should be noted that timing t5 of the second round in FIG. 20 shows a state in which the electric currents flowing in the phase A and phase B are shut off all together.

[0078]

Next, a relation between the stopper position and the rotor stop position at one turn of the electric angle in the tilt motor 56 is described by referring to FIG. 21. A vertical array on the left side of FIG. 21 shows the phases of the electric angle, and a vertical array on the right side of this figure shows the phases of the rotor 85. Here, in FIG. 21, a sign L denotes a magnetic field vector generated by the coil and a sign M denotes the magnetic field vector generated by the rotary shaft 56a having a magnet. In addition, numeral 88 denotes a stopper that is obtained by the fitting contact of the rib portion 58c provided in the lower plane of the tilt cam 58 with the stopper boss 59a provided in the spindle chassis 44.

[0079]

In any one of those cases among: the case in which the rotor 85 stops between the phase A+ and the phase B+ at timing t1 such that the magnetic field vector L generated by the coil, which is electrically determined, is directed to the first position t1; the case in which the rotor 85 stops opposing the phase B+ after shifting to timing t2 such that the electrically determined magnetic field vector L is directed to the second

position t2; the case in which the rotor 85 stops between the phase B+ and the phase A- after shifting to timing t3 such that the electrically determined magnetic field vector L is directed to the third position t3; and the case in which the rotor 85 stops opposing the phase A- after shifting to timing t4 such that the electrically determined magnetic field vector L is directed to the fourth position t4, the magnetic field vector M generated by the rotary shaft 56a, which is mechanically determined by the stopper 88, is at a position fittingly contacted to the stopper 88 in clockwise direction as shown in FIG. 21. Since an angle formed in the counterclockwise direction by the magnetic field vector M and the magnetic field vector L at this time is 180° or more in any one of those cases, there is no force generated in the counterclockwise direction in the rotor 85. Therefore, there occurs no phase shift in the rotor 85 since the state of keeping the mechanically determined magnetic field vector M pressed to the stopper 88 is maintained.

[0080]

On the other hand, in any one of those cases among: the case in which the rotor 85 stops between the phase A- and the phase B- after shifting to timing t5 such that the electrically determined magnetic field vector L is directed to the fifth position t5; the case in which the rotor 85 stops opposing the phase B- after shifting to timing t6 such that the electrically determined magnetic field vector L is directed to the sixth

position t6; the case in which the rotor 85 stops between the phase B- and the phase A+ after shifting to timing t7 such that the electrically determined magnetic field vector L is directed to the seventh position t7, and the case in which the rotor 85 tops opposing the phase A+ after shifting to timing t0 such that the electrically determined magnetic field vector L is directed to the 0th position t0 (which is the eighth position t8), the magnetic field vector M generated by the rotary shaft 56a, which is mechanically determined by the stopper 88, is at a position away from the stopper 88. More specifically, since the angle formed in the counterclockwise direction by the magnetic field vector M and the magnetic field vector L is reduced to 180° or less in those cases, the force toward the angle smaller than 180°, more specifically the force toward the counterclockwise direction, is generated in the rotor 85. Therefore, there occurs the phase shift in the rotor 85 by the force generated in the counterclockwise direction.

[0081]

In a case that the phase shift occurs in the rotor 85 as described above, the electrical phase and mechanical phase of the tilt motor 56 becomes unmatched since the phases remain in the shifted state. Then, the electrical phase and mechanical phase of the tilt motor 56 are set to mutually match at the time of installing the above-described tilt cam 58. For example, work of matching the phases can be carried out in the following

manner. More specifically, the positive voltage is impressed only to the phase A of the tilt motor 56 at the time of assembling the tilt motor 56 and the base unit 15 is assembled such that this unit is set at the tilt up stopper position in this state. Accordingly, the electrical phase and mechanical phase of the tilt motor 56 can be matched at the tilt up stopper position of the base unit 15. As a result, the step-out of the motor due to the unmatched phases between the electrical phase and mechanical phase of the tilt motor 56 can be prevented and the accuracy in obtaining the tilt reference position can be improved with the prevention or restriction of the step-out.

[0082]

Next, the step-out of the tilt motor 56 is described. The "step-out" in this case means a state in which only the internal magnetic field of a stator rotates although the rotor of the tilt motor 56 does not move. More specifically, the rotation of the rotary shaft 56a is stopped when the rib portion 58c of the tilt cam 58 is brought into fitting contacts with the stopper boss 59a of the spindle chassis 44 by the rotation of the rotary shaft 56a of the tilt motor 56. In a case that the voltage current is applied further under such state, the rotor 85 of the rotary shaft 56a is energized to rotate further, however the rotor 85 is not allowed to rotate since the rotation thereof is mechanically restricted by the stopper 88 because of the fitting contact of the rib portion 58c and stopper boss 59a. As a result,

there occurs the "step-out" in which only the internal magnetic field of the stator rotates without moving the rotor of the motor.

[0083]

A tilt neutral position can be obtained using the step-out of the tilt motor 56. Next, an operation procedure for obtaining the tilt neutral position is described. The first method is a method of determining the tilt neutral position such that the reference position is obtained by stepping out the motor intentionally at a mechanical stopper position (either the tilt down stopper position or tilt up stopper position) of the tilt drive and the motor is moved by predetermined pulses from this reference position. This embodiment is set such that the tilt motor 56 makes two turns per every 40 steps in the two-phase excitation and the pickup chassis 45 can oscillate in the vertical direction from the tilt down stopper position to the tilt up stopper position by the motor's two turns.

[0084]

Since an initial position of the tilt operation is not known, the tilt motor 56 is rotated in the tilt up direction (or tilt down direction) by predetermined specific steps (for example, 40 steps). At this time, in a case of normal operation in which the initial position is set at the tilt minimum position, the pickup chassis comes into fitting contact with the stopper at a position being rotated by 40 pulses and reaches the

tilt maximum position as shown using parentheses in FIG. 22. Therefore, the step-out does not occur in this case. Therefore, the reference position is set at this tilt maximum position (or tilt minimum position), and the rotary shaft 56a is reversely rotated in the reverse direction (tilt down direction) by the predetermined 20 steps (one half of 40 pulses) from this reference position. Accordingly, a tilt neutral point can be obtained so that the pickup chassis 45 can be set at the tilt neutral position.

[0085]

On the other hand, in the case that the initial position is shifted from the tilt minimum position, the pickup chassis comes into fitting contact with the stopper before the rotation of 40 pulses is completed, and therefore the step-out occurs in the motor 56 by the remaining pulses thereafter (40 pulses in total). Since the position where the rotary shaft 56a is rotated by the total 40 steps including the rotation of the internal magnetic field caused by the step-out is the tilt maximum position, this tilt maximum position is set as the reference position. Further, similarly to the normal operation, the rotary shaft 56a is reversely rotated in the reverse direction (tilt down direction) by the 20 steps from this reference position and thereby the tilt neutral point can be obtained.

[0086]

The second method is a method of obtaining the tilt neutral position such that, after obtaining the tilt reference position, the tilt neutral position is shifted to the tilt neutral point obtained by measuring a position of reference, where there is no warp, instead of the mechanically determined tilt neutral point. This embodiment is set such that the tilt motor 56 makes two turns per every 80 steps in the one-two phase excitation and the pickup chassis 45 can oscillate in vertical direction from the tilt down stopper position to the tilt up stopper position by the motor's two turns.

[0087]

Since the initial position of the tilt operation is not known, the tilt motor 56 is rotated in the tilt up direction (or tilt down direction) by predetermined specific steps (for example, 80 steps). At this time, in the case of the normal operation in which the initial position is set at the tilt minimum position, the pickup chassis comes into fitting contact with the stopper at a position rotated by 80 pulses and reaches the tilt maximum position as shown in FIG. 22, and therefore no step-out occurs in the tilt motor 56. Then, this tilt maximum position is set as the reference position and the pickup chassis 45 can be set at the tilt neutral position by moving the rotary shaft 56a in the reverse direction (tilt down direction) from this reference position to the predetermined neutral point.

[0088]

The predetermined neutral point can be set as follows, for example. The reference optical disk without warp, for example, is reproduced, and the tilt neutral point is set at the tilt position where the readout signal for the recorded information of the optical disk becomes the most excellent. The number of steps from the tilt neutral point to the tilt maximum position (or tilt minimum position) of the reference position is written in a nonvolatile memory or the like, and the rotary shaft is moved to the tilt neutral point based on this written number of steps. Accordingly, even if there are variations in the position of the mechanically determined neutral point, the pickup chassis 45 can be set at the tilt neutral position using the neutral point recorded in the memory while disregarding such variations.

[0089]

According to such disk drive device 11 as described above, the operation of reproducing the optical disk 33 can be executed as follows, for example. First, the disk drive device 11 is set in a power-on state, and thereafter an eject button is depressed to draw out the disk tray 13 and to be in an eject state, for example, and thereby the disk holding portion 34 is exposed so that the optical disk 33 can be loaded on the large diameter portion 34a or small diameter portion 34b.

[0090]

The intended optical disk 33 is mounted on the disk holding portion 34, and thereafter a loading mechanism is operated by

depressing a reproduction button, for example, so that the disk tray 13 is brought to the disk loading portion. FIG. 10 is a diagram showing such state. It should be noted that the chuck holder 80 shown in FIG. 10 and FIG. 11 is made into a shape that can close simultaneously the whole of the disk holding portion 34 and opening portion 35 by slightly modifying the chuck holder 80 shown in FIG. 9.

[0091]

In a case that the loading motor 20 is driven by operating the reproduction button and the like when the disk tray 13 is transported, the torque is transmitted from the driving pulley 21 to the coupled driving pulley 23 through the rubber belt 22. The torque of the coupled driving pulley 23 is transmitted from the middle gear 25b of the intermediary gear 25 to the driving gear 26 through the upper gear 25a. The torque of the driving gear 26 is transmitted to the rack of the disk tray 13, and thereby the disk tray 13 moves to the rear side of the main chassis 12 by being guided along the tray guide 31 and guide pins 32a and 32b. At this time, the chuck cam 27 does not move since the lower gear 25c of the intermediary gear 25 is not engaged with the rack 27a of the chuck cam 27 while the disk tray 13 moves to the most rear end.

[0092]

Subsequently, the upper operation pin 27c of the chuck cam 27 enters the cam groove provided in the lower plane of the disk

tray 13 when the disk tray 13 moves to the most rear end, and the chuck cam 27 slightly moves by being guided along the cam groove. As a result, the rack 27a of the chuck cam 27 is engaged with the lower gear 25c so that the torque can be transmitted from the loading motor 20. On the other hand, the engagement between the rack of the disk tray 13 and the driving gear 26 is released when the disk tray 13 reaches the most rear end, and then the torque becomes unable to be transmitted from the loading motor 20.

[0093]

Next, the chuck cam 27 moves in the direction of being away from the loading motor 20 against the spring force of the tension coil spring 29 when the torque of the loading motor 20 is transmitted from the lower gear 25c to the rack 27a. Because of the movement of the chuck cam 27, the cam pin 28 of the base holder 14 engaged with the cam groove 27b moves from the lower horizontal portion of the cam groove 27b to the upper horizontal portion through the slope portion. As a result, the base holder 14 is oscillated upward through the axle portion 14a of the rear end portion and is brought into a state of being approximately horizontal. FIG. 11 is a diagram showing such state.

[0094]

When the front portion of the base holder 14 is lifted at this time, the turntable 47 supported on the oscillating side of the base unit 15 that is elastically supported at the base

holder 14 through the insulator 43 enters the opening portion 35 of the disk tray 13. Accordingly, the chucking ring 54 installed in the turntable 47 enters a center hole 33a of the optical disk 33 so that the optical disk 33 is mounted on the turntable 47. At this time, the optical disk 33 is slightly lifted by the turntable 47 and the chuck plate 81 held in the chuck holder 80 is attracted to the magnet 47a that is built in the turntable 47.

[0095]

As a result, the optical disk 33 is held between the turntable 47 and the chuck plate 81. Accordingly, the optical disk 33 and the turntable 47 combined in the rotational direction is rotationally driven at predetermined rotation by the torque of the spindle motor 51.

[0096]

Simultaneously thereto or around that time, the feed motor 70 is driven. As a result, the feed shaft 96 is rotated so that the slide member 75 of the optical pickup device 48 moves in the direction of approaching the turntable 47 according to the rotational direction of the feed shaft. The tilt of the optical disk 33 loaded on the turntable 47 can be detected by the movement of the optical pickup device 48 in the direction of approaching the turntable 47. A tilt amount of the optical disk 33 is detected as follows, for example.

[0097]

Specifically, the information recording plane of the optical disk 33 is irradiated with laser light from the objective lens 68a of the optical head 68 when the optical pickup device 48 moves from the outer side to the inner side in radial direction of the optical disk 33, and time to the laser light returned is detected continuously. The tilt amount of the optical disk 33 can be detected by comparing the detected time obtained thereby.

[0098]

Next, an operation of correcting the tilt amount of the optical disk 33 detected as described above is further described. It is assumed that the pickup chassis 45 is presently in a state of being tilted on the side of turntable 47 to the spindle chassis 44 of the base chassis 36 as shown in FIG. 12. In a case that the tilt of the optical disk 33 is detected in this state, the tilt motor 56 is driven so that the torque is transmitted from the rotary shaft 56a to the tilt gear 57. The torque is transmitted from the gear portion 58a engaged with the tilt gear 57 to the tilt cam 58 by the rotation of the tilt gear 57 so that the tilt cam 58 is rotationally driven according to an amount of rotation of the tilt motor 56.

[0099]

The cam piece 73 of the pickup chassis 45 is constantly biased toward the cam plane 58b of the tilt cam 58 by the spring force of the plate spring 74. As a result, the pickup chassis 45

is turned about the right and left pair of turnable axle portions 63 positioned at the approximately center part as the center of the turn, since the cam piece 73 moves along the cam plane 58b, and then a posture is changed in the counterclockwise direction in FIG. 12. When the highest position of the cam plane 58b comes to contact with the cam piece 73 by the turn of the tilt cam 58, the pickup chassis 45 is into a state of being tilted backward as shown in FIG. 13.

[0100]

The reproduction of the information signal recorded on the information recording plane of the optical disk 33 is performed by the optical pickup device 48 at the position where the tilt amount of the optical disk 33 is adjusted using such adjustment of tilt mechanism. The reproduction of the information signal by using the optical pickup device 48 is performed as follows, for example. Specifically, the information recording plane is irradiated with the laser light from the objective lens 68a of the optical head 68 and the reflected light of the irradiated laser light is received through the objective lens 68a so that the information signal recorded on the information recording plane is reproduced.

[0101]

In addition, an opposite operation from the above-described operation at the time of the loading is executed at the time of the ejection of the disk tray 13. When the eject operation is

selected by depressing the eject button, for example, the loading motor 20 is rotationally driven in the reverse direction so that the torque is transmitted to the rack 27a through the driving pulley 21, the rubber belt 22, the coupled driving pulley 23, and the lower gear 25c of the intermediary gear 25. Accordingly, the chuck cam 27 moves in the direction of approaching the loading motor 20 so that the cam pin 28 is pushed lower. As a result, the base holder 14 changes from the state of being horizontal shown in FIG. 11 to the state of being tilted forward shown in FIG. 10.

[0102]

Accordingly, the base unit 15 supported at the base holder 14 is oscillated downward so that the turntable 47 mounted with the optical disk 33 is moved to the lower side. The chuck plate 81 is off by the descending operation of the turntable 47. Subsequently, the chucking ring 54 of the turntable 47 slips out from the center holt 33a of the optical disk 33 and the optical disk 33 is mounted on the disk holding portion 34 of the disk tray 13. The disk tray 13 can be drawn out by being into such state as described above.

[0103]

Although having described the embodiment above, the present invention is not limited to the embodiment described above; for example, the example using the read-only optical disk such as the CD and CD-ROM as the information recording medium is

described in the above-described embodiment, however, a recordable optical disk or optical-magnetic disk on which information is newly writable can be applied as the information recording medium. Moreover, the example using the optically-based disk such as the CD in a bare state is described in the above-described embodiment, but an information recording medium holding the optically-based disk in a disk cartridge may be used.

[0104]

Further, the disk drive device of the disk tray method and the head feed mechanism thereof for reproducing (reading) the information recorded on the optically-based disk are described in the above-described embodiment, but the present invention is obviously applicable to a recording-only disk drive device for performing only the recording of information and also applicable to a disk drive device and head a feed mechanism thereof capable of performing both recording and reproduction of information. Thus, the present invention is not limited to the embodiment described above and various modifications and alterations are possible without departing from the scope and sprit thereof.

[0105]

[Effect of the Invention]

As described above, since the disk recording and/or reproducing apparatus according to claim 1 of the present invention is configured such that the stepping motor is used as the driving source for the tilt operation mechanism and the

motor drive circuit is provided to drive the stepping motor at the time of starting the operation of recording and/or reproducing the information signal in order that the tilt of the pickup chassis is set at the predetermined neutral position, the tilt of the pickup chassis can be set at the predetermined neutral position to the spindle chassis without using the tilt sensor and also the tilt can be controlled accurately despite of the comparatively simple control. Further, there can be obtained such an effect that the accuracy control of tilt sensor and the like need not to be considered since the tilt sensor is not used.

[0106]

Since the disk recording and/or reproducing apparatus according to claim 2 of the present invention is configured such that the reference position is set by rotationally driving the stepping motor in one direction and this reference position is compared with the predetermined neutral position to rotationally drive the stepping motor in the reverse direction by the predetermined number of pulses, there can be obtained such an effect that the tilt of the pickup chassis can be set at the predetermined neutral position.

[0107]

Since the disk recording and/or reproducing apparatus according to claim 3 of the present invention is configured such that the reference position is set by rotationally driving the stepping motor in one direction and the stepping motor is driven

rotationally in the reverse direction by the predetermined number of pulses from this reference position, there can be obtained such an effect that the tilt of the pickup chassis can be set at the predetermined neutral position.

[0108]

Since the disk recording and/or reproducing method according to claim 4 of the present invention is configured such that the motor drive circuit is operated at the time of starting the operation of recording and/or reproducing the information signal in order that the tilt of the pickup chassis is set at the predetermined neutral position, the tilt of the pickup chassis can be set at the predetermined neutral position to the spindle chassis without using the tilt sensor and further the tilt can be controlled accurately despite of the comparatively simple control. Moreover, there can be obtained such an effect that the accuracy control of tilt sensor and the like need not to be considered since the tilt sensor is not used.

[0109]

Since the disk recording and/or reproducing method according to claim 5 of the present invention is configured such that the reference position is set by rotationally driving the stepping motor in one direction and this reference position is compared with the predetermined neutral position to rotationally drive the stepping motor in the reverse direction by the predetermined number of pulses, there can be obtained such an

effect that the tilt of the pickup chassis can be set at the predetermined neutral position.

[0110]

Since the disk recording and/or reproducing method according to claim 6 of the present invention is configured such that the reference position is set by rotationally driving the stepping motor in one direction and the stepping motor is rotationally driven in the reverse direction by the predetermined number of pulses from this reference position, there can be obtained such an effect that the tilt of the pickup chassis can be set at the predetermined neutral position.

[Brief Description of Drawings]

[FIG. 1] An external appearance perspective view showing an embodiment of a disk drive device according to the present invention;

[FIG. 2] An exploded perspective view of a disk drive device shown in FIG. 1 according to the present invention;

[FIG. 3] A diagram showing a magnified view of an essential portion of FIG. 2, which is a perspective view of a main chassis and other portions related to a disk drive device according to the present invention;

[FIG. 4] A perspective view showing a disk tray related to a dist drive device according to the present invention;

[FIG. 5] A diagram showing a magnified view of an essential portion of FIG. 2, which is a perspective view showing a base

chassis and a base holder related to a disk drive device according to the present invention;

[FIG. 6] A diagram showing a base unit related to a disk drive device according to the present invention, which is a perspective view showing a state in which a biaxial cover is disassembled;

[FIG. 7] A diagram showing a base unit related to a disk drive device according to the present invention, which is a front view showing a state in which a turntable is cross-sectioned;

[FIG. 8] An exploded perspective view of a base unit related to a disk drive device according to the present invention;

[FIG. 9] A diagram showing a magnified view of an essential portion of FIG. 2, which is a perspective view showing a chuck plate and the like related to a disk drive device according to the present invention;

[FIG. 10] A diagram showing a disk drive device cross-sectioned in a tray transport direction according to the present invention, which is a cross-sectional view showing an unloading state in which a turntable is lowered;

[FIG. 11] A diagram showing a disk drive device cross-sectioned in a tray transport direction according to the present invention, which is a cross-sectional view showing a loading state in which a turntable is ascended;

[FIG. 12] A diagram showing a base chassis related to a disk drive device according to the present invention, which is a lateral view showing a state in which a pickup chassis is tilted forward;

[FIG. 13] A diagram showing a base chassis related to a disk drive device according to the present invention, which is a lateral view showing a state in which a pickup chassis is tilted backward;

[FIG. 14] A perspective view in which a tilt cam of a tilt operation mechanism related to a disk drive device according to the present invention is viewed from the side of rib portion;

[FIG. 15] A block diagram showing a schematic configuration of a disk drive device according to the present invention;

[FIG. 16] An explanatory diagram showing a schematic configuration of a tilt drive circuit related to a disk drive device according to the present invention;

[FIGS. 17] Explanatory diagrams respectively showing rotor stop positions in a two-phase excitation state of a tilt motor driven by a tilt drive circuit related to a disk drive device according to the present invention;

[FIG. 18] A timing chart showing an excitation pattern in a two-phase excitation state of a tilt motor driven by a tilt drive circuit related to a disk drive device according to the present invention;

[FIGS. 19] Explanatory diagrams respectively showing rotor stop positions in a one-two phase excitation state of a tilt motor driven by a tilt drive circuit related to a disk drive device according to the present invention;

[FIG. 20] A timing chart showing an excitation pattern in a one-two phase excitation state of a tilt motor driven by a tilt drive circuit related to a disk drive device according to the present invention;

[FIG. 21] An explanatory diagram showing a relation between a stopper position and a rotor stop position at electric angle one turn of a tilt motor driven by a tilt drive circuit related to a disk drive device according to the present invention;

[FIG. 22] An explanatory diagram showing a concept of initialization operation of a tilt motor driven by a tilt drive circuit related to a disk drive device according to the present invention; and

[FIG. 23] A perspective view showing a disk drive device of related art.

[Description of Reference Numerals]

11 Disk Drive Device, 12 main Chassis, 13 Disk Tray, 14 Base Holder, 15 base Unit, 20 Loading Motor, 27 Chuck Cam, 33 Optical Disk (Optically-based disk), 35 Opening Portion, 36 Base Chassis, 44 Spindle Chassis, 45 Pickup Chassis, 47 Turntable, 48 Optical Pickup Device, 51 Spindle Motor, 56 Tilt Motor, 58 Tilt Cam, 68 Optical Head, 69 Feed Shaft, 70 Feed Motor, 73 Cam Piece,

76 Slidable Rack, 85 Rotor, 86a, 86b phase A, 87a, 87b phase B, 88 Stopper, 90 PLL Circuit, 91 Jitter Measurement Circuit, 92 System Controller, 93 Servo Controller, 94 Motor Drive Circuit, 97a, 97b Coil

[Name of Document] Abstract

[Summary]

[Problem] There has been such a problem that a disk recording and/or reproducing apparatus is not economical and also tilt control thereof is complicated since a tilt sensor is required and, moreover, the tilt sensor needs to be installed accurately.

[Solving Means] A stepping motor 56 is used as a driving source for a tilt operation mechanism and the stepping motor 56 is driven at the time of starting an operation of recording and/or reproducing an information signal in order that a tilt of a pickup chassis 45 is set at a predetermined neutral position.

[Selected Diagram] FIG. 1